Abstract

A computer program, GeoSteamNet, for the numerical simulation of steam transport in geothermal pipeline networks is written in Visual Studio .NET. The program considers (a) internally consistent thermodynamic properties of water, and (b) a numerical algorithm based on the principles of conservation of mass, linear momentum (Newton’s second law), and energy (the first and second laws of thermodynamics). Instability in the algorithm is observed as a consequence of ideal gas behavior of steam at low pressure, which is resolved by setting the lower limit of pressure to 2.0×10^5 Pa. An ActiveX control, SteamTablesGrid, is used to calculate the thermodynamic properties of water. A study of the interrelationship among thermodynamic state variables like temperature, pressure, volume, internal energy, etc. indicates the internal consistency in the thermodynamic properties of steam only. The application of GeoSteamNet is demonstrated in the management and optimization of steam flow in a hypothetical geothermal power plant with two wells and one production unit. GeoSteamNet calculates all the parameters like fluid velocity, different types of energies such as heat loss, mechanical (kinetic and potential) energy, thermal energy, frictional energy, and total energy. Thus, the mass, linear momentum and energy balances at each nodal point in the pipeline network are used to validate the algorithm. Additionally, the computer program can also be used efficiently in the design and construction of geothermal pipeline network.

Keywords

Steam flow, numerical simulation, SteamTablesGrid, GeoSteamNet, PipeLine, Visual Studio .NET.